A Class of Multilevel Algorithms for Nonlinear Constrained Optimization

Decomposition:

minimize f(x)
subject to C(x) = 0

(M is the number of fully coupled blocks or disciplines; $x \in R^n$ - design variables)

→

minimize f(x)
subject to $C_1(x) = 0$
$C_2(x) = 0$
$C_M(x) = 0$

e.g.

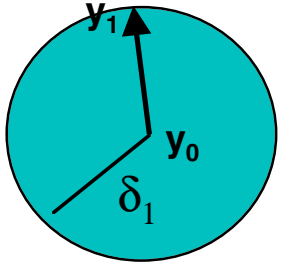
EXAMPLE

minimize -L /D
subject to AERO
STRUCT
. . .
other disciplines

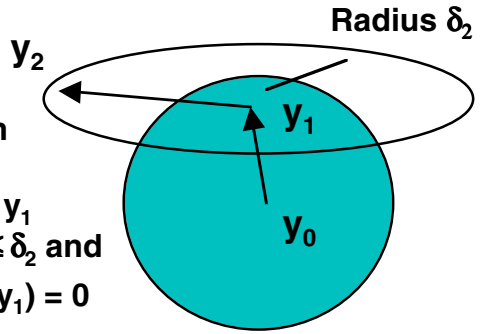
Computing One Step: (M=2, n=3)

$y_0 = x_c$

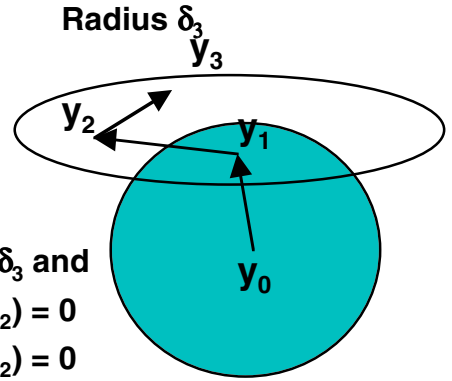
approx min model of $\|C_1(y)\|^2$ at y_0 st $\|y-y_0\|^2 \le \delta_1$ to obtain y_1



approx min model of $\|C_2(y)\|^2$ at y_1 st $\|y-y_1\|^2 \le \delta_2$ and $\nabla C_1(y_0)^T(y-y_1) = 0$ to obtain y_2



approx min model of f(y) at y_2 st $\|y-y_2\|^2 \le \delta_3$ and $\nabla C_1(y_0)^T(y-y_2) = 0$ $\nabla C_2(y_1)^T(y-y_2) = 0$ to obtain y_3



$x_+ = y_3$

Preliminary Numerical Results:

H&S Problem	# Iter Multi	# Iter NPSOL	#Fn Eval Multi	# Fn Eval NPSOL
8	10	6	12	8
3	40	37	42	65
40	28	46	50	136
42	12	12	14	18
77	56	F	62	32
78	33	39	42	55

Hock and Schittkowski test set problems; compared with NPSOL

("F" - exceeded max allowable number of iterations)